METHOD AND MACHINE FOR FORMING ANNULAR BANDS

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Fig.1

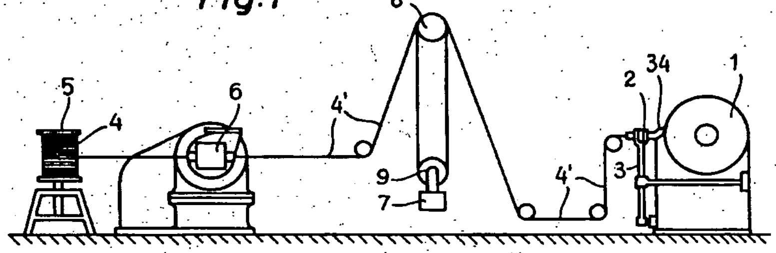


Fig.2

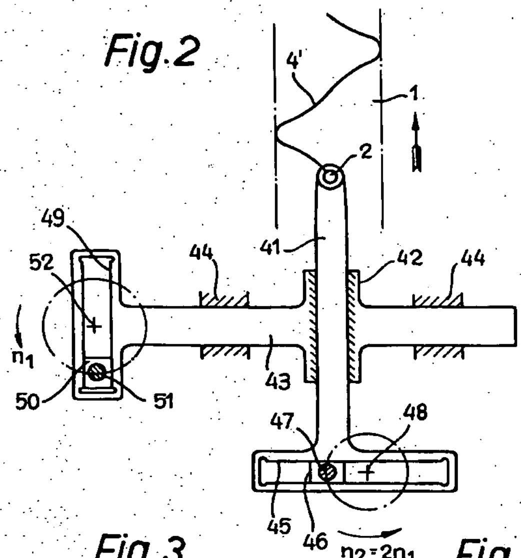


Fig.3

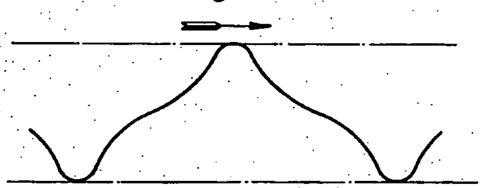

Fig.3a

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METHOD AND MACHINE FOR FORMING ANNULAR BANDS

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Fig.4

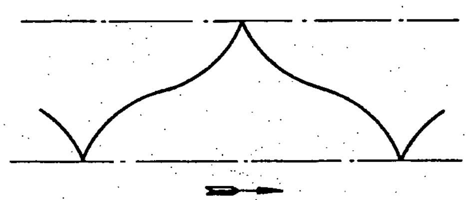

Fig.4a

Fig.5

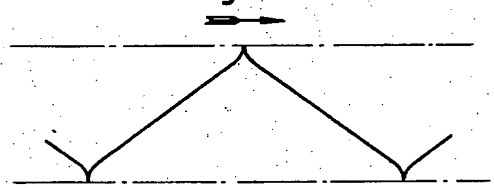

Fig.5a

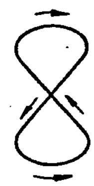

Fig.6

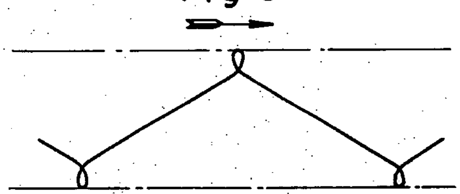

Fig.6a

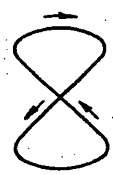

Fig.7

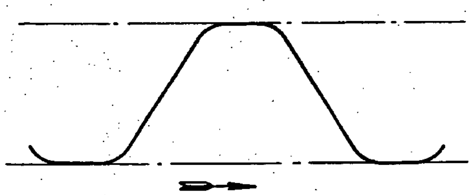

Fig.7a

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Fig.8

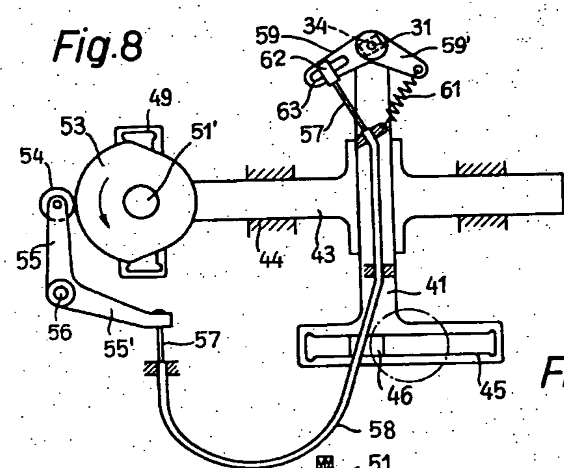


Fig.9

Fig.10

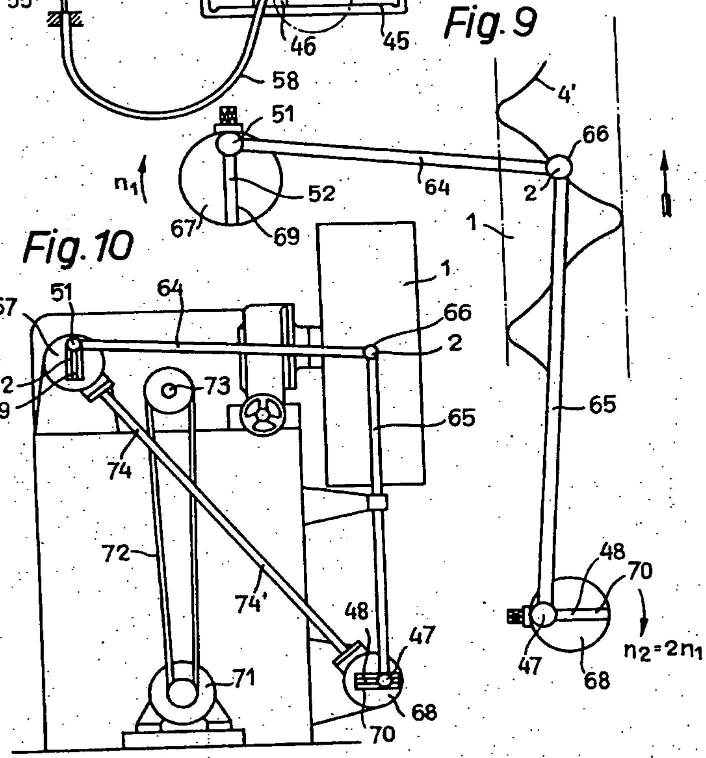


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Fig.11

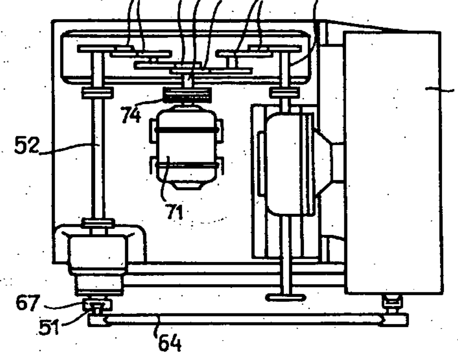


Fig.14

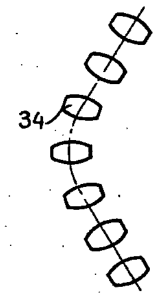


Fig.12

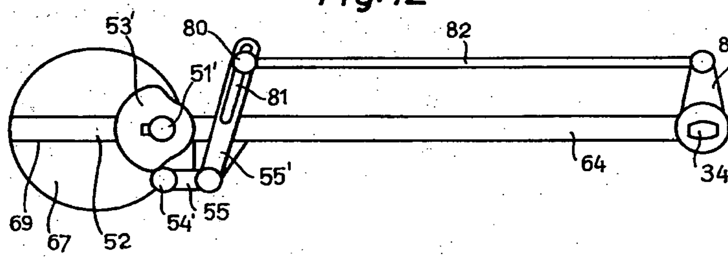


Fig.13

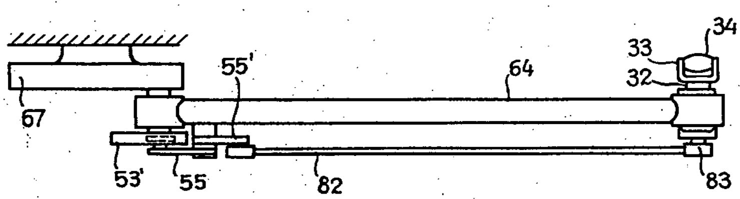


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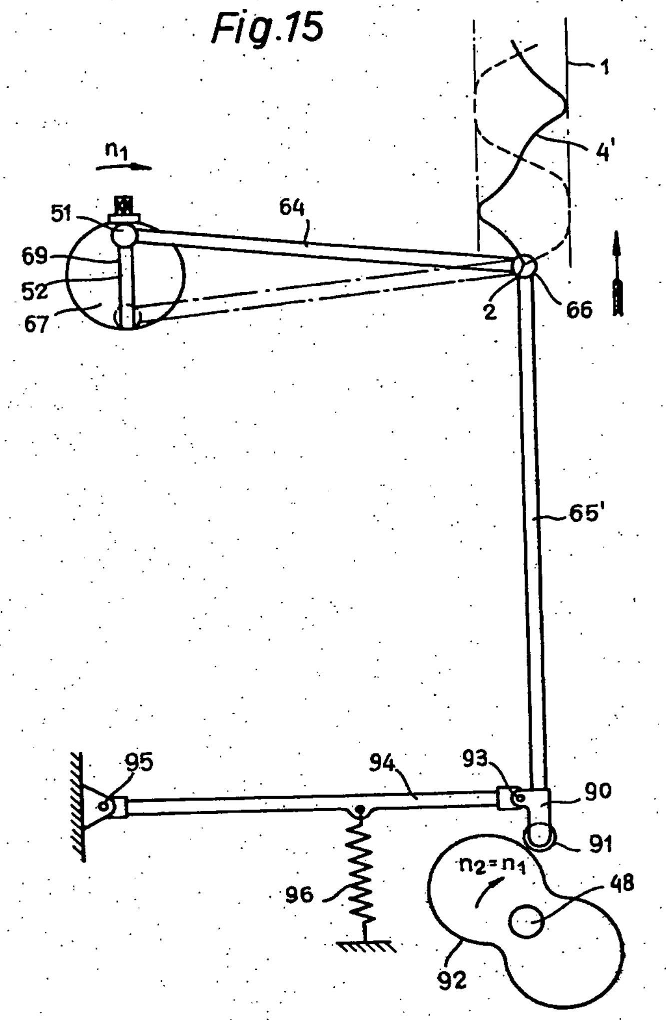
Fig.15

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METHOD AND MACHINE FOR FORMING ANNULAR BANDS

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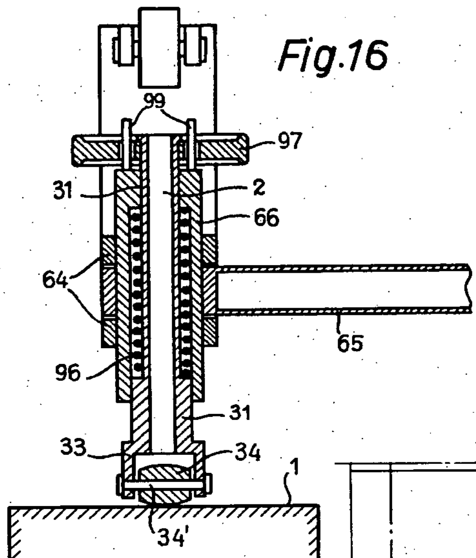


Fig.16

Fig.17

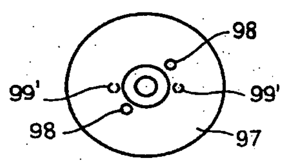


Fig.18

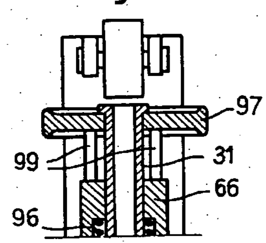


Fig. 19

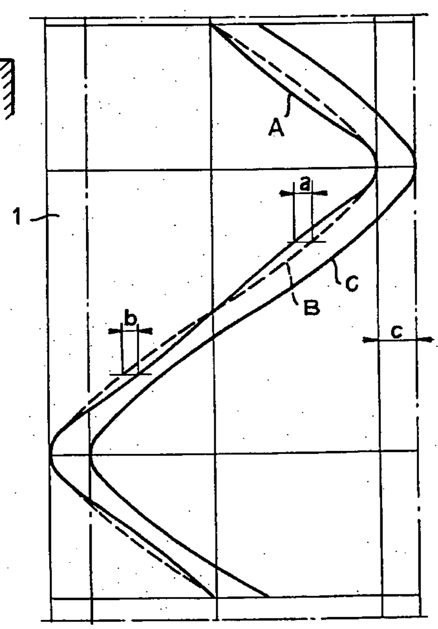


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Fig.20

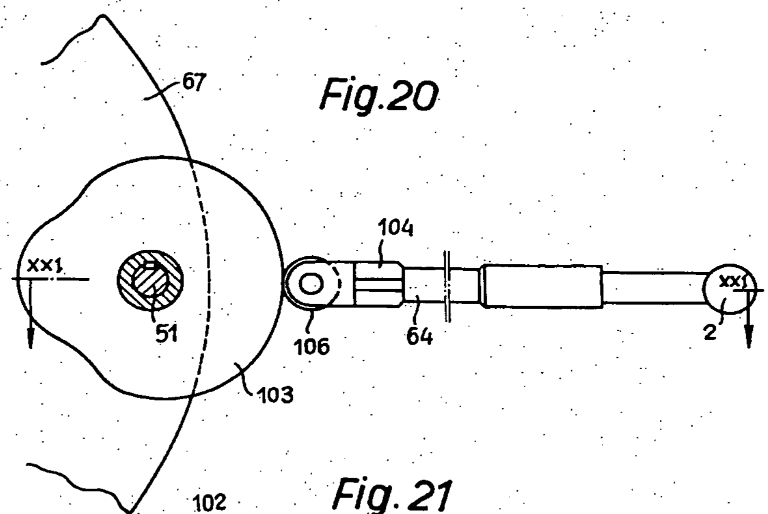



Fig. 21

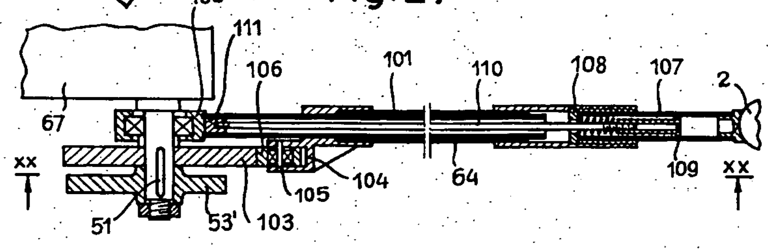
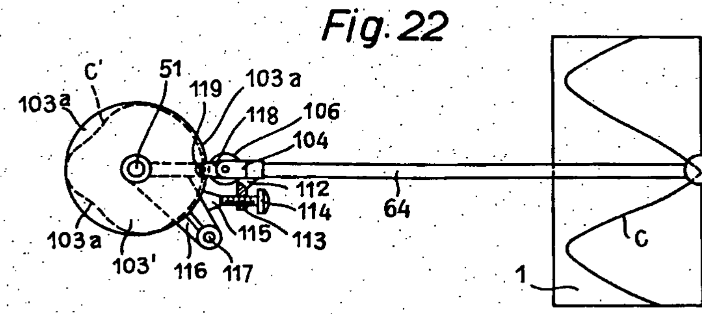



Fig. 22

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United States Patent Office

3,082,140

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3,082,140

# METHOD AND MACHINE FOR FORMING ANNULAR BANDS

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Claims priority, application Italy Aug. 5, 1957
6 Claims. (Cl. 156—175)

This invention relates to a method of forming on a collapsible drum from one or more endless threads lined with raw rubber or the like, annular bands even of large width, more particularly convenient for the resisting structures of motor vehicle wheel tires, and a machine for carrying out said method.

The improved method substantially consists in providing a drum, in coating the drum surface with an adhesive, rotating the drum, stretching the thread and laying it on the rotating drum as it is reciprocated, directly before its contact with the drum surface by means of a thread guide through which the thread is passed from one side to the other of the drum surface along a closed line confining a definite area situated in a plane parallel with the drum axis, whereby the thread is laid on the drum along a substantially zig-zag line.

Before laying it on the drum the thread is conveniently coated with a raw rubber mixture, or the drum face coated with an adhesive is provided before laying the thread with a crude rubber layer in which the bare thread is embedded.

As the thread is laid on the drum it is pressed towards the drum axis.

By effect of the rotation of the drum combined with the movement of the thread guide laying the thread on the drum face, the thread is laid on the drum along a zig-zag line with a certain pitch which is the function of the drum radius, peripheral speed of the drum and closed line over which the thread guide laying the thread is moved.

By adopting for the pitch a value

$$p=\frac{2\pi(R+s/2)+s}{2n}$$

wherein R is the drum radius, $n$ any whole number and $s$ the thickness of the raw rubber lined thread, on forming the band section of the zig-zag line along which the coated thread is laid are obtained on each successive rotation of the drum, which contact one another thereby affording a continuous band structure.

The thread guide laying thread comprises a bush through which the thread is passed, the drum being rotated as many times as the value $s$ is contained in the pitch. It is thus possible to cover the whole drum surface by one endless thread over the desired width, the result being an annular band composed of raw rubber thread sections parallel with one another, distributed over two layers at a certain angle to each other, the said annular band being free from discontinuities thanks to the adhesion of the raw rubber mix or plastic sheath enclosing the thread and forming through a special calendering step effected on laying of the thread a continuous layer within which the adjacent and intersecting thread sections merging into one another are embedded and further connected together by effect of the vulcanization ultimately carried out on the article incorporating the annular band.

According to this invention the thread may be laid in such manner that the abovementioned sections are spaced from one another, but for some uses the raw rubber should fill the interstices between the sections. In this case also a bare thread can be employed which is em-



bedded on laying into a raw gum layer previously provided on the drum.

Where the band is to be made up of a plurality of layers of intersecting thread sections, as above described, a layer of raw rubber or the like should be interposed between the layers.

It has heretofore been proposed to form the endless band by laying one thread only. When bands of considerable width are manufactured, more particularly bands the various longitudinal zones of which should exhibit different properties, two, three or a plurality of threads can be employed, which are each laid by a special thread guide to form a corresponding longitudinal band portion.

The individual thread guides are transversely displaced by an extent corresponding to the length of the band portion to be made therefrom, each thread guide being moved by an independent control adapted to provide the required conditions.

For instance, when manufacturing the whole resisting structure of tire casings, three thread guides may be employed for laying three threads over corresponding juxtaposed longitudinal portions, the central thread guide adapted to form the cincturing structure laying its thread along segments at a small angle to the longitudinal plane, the lateral thread guides adapted to form the resisting carcass structure involving the sides of the tire casing laying the threads along segments forming an angle near 90° to the said longitudinal plane. The laying pitch for the former and the latter threads may be selected to form parallel segments intersecting the overlying layer, closely juxtaposed, when the threads have been previously lined, or more or less spaced when employing either lined or bare threads.

Interconnection of the resisting structures of the various juxtaposed portions may be effected by means of threads extending along a longitudinal plane laid at the demarcation line between the juxtaposed portions.

Such threads laid along a longitudinal plane or approximately longitudinal plane can be arranged at the margins also of each band portion or at the margin of the band itself, when the latter comprises a single portion being formed from one endless thread, as well as in the middle plane of the said portion and, if desired, at intermediate regions.

The connecting threads which are adapted to improve rigidity of the structure, such as is advantageous at the cincturing region for pneumatic tires, can be laid before or after forming the zig-zag line layers, in special cases they may be even made at the same time as the zig-zag thread, to interlock with the latter.

On forming endless bands from two or more zig-zag threads at corresponding juxtaposed longitudinal band portions, threads differing in properties in respect of their raw rubber lining also may be employed in order to meet requirements arising in the use of the band at the various longitudinal portions composing the band.

According to this invention two or more threads can be simultaneously laid along parallel lines throughout the width to be covered by means of two or more thread guides securedly fixed to one another aligned along a plane normal to the axis of the revolving drum.

Reference has been made above to a thread being laid on the drum, it being understood that throughout the specification the term "thread" should be understood as including elementary threads coupled and twisted together as well as cables made from extra strong elementary threads, more particularly wires.

In the machine according to this invention the thread guide is imparted a movement which is the combination of a transverse motion and a longitudinal motion, either motion of them varying according to a law controllable at will. The longitudinal movement imparted to the

thread guide should be effected in the same direction of rotation of the drum, but in certain cases may be effected in a contrary direction thereto.

The improved machine is moreover fitted with a roller which is pressed by an adjustable resilient pressure on the thread at a region coinciding with the region at which the thread is laid on the drum or at a region immediately past the latter.

The roller is controlled so that its axis of rotation is in a plane perpendicular to the instantaneous laying direction.

Since the direction of the laying line is gradually varied at the reversing point, the control for varying orientation of the pressure roller should be gradually effected so as to meet with the above requirement for the roller axis to extend always perpendicularly to the tangent to the laying curve. The control may be effected for instance by means of a cam.

The improved machine comprises generally a support carrying the thread spools; a device for lining the thread with the raw rubber or suitable plastic; a device for stretching the thread supplied to the thread guide laying it on the drum; means for controlling adjusting movement of the thread guide and rotation of the drum; a pressure roller acting on the thread as the latter is being laid; means for maintaining the roller axis constantly perpendicular to the instantaneous direction of laying of the thread.

The drum is of the collapsible type to enable removal of the continuous band when completed.

A preferred embodiment of the improved machine comprises two crank mechanisms having an adjustable arm, one connecting rod being situated in its middle position in a plane extending through the drum axis, the other connecting rod extending in its middle position perpendicular to the former and being situated in a plane normal to the drum axis, the ends of the said two connecting rods remote from the cranks being articulated in each other by means of the thread guide laying the thread.

The crank driving the connecting rod situated in the plane normal to the drum axis is driven at twice the speed of rotation of the other crank.

Though this embodiment is preferred on account of the simplicity in manufacture and operation, it is objectionable in that the thread cannot be laid on the drum accurately along any desired line, more particularly along a symmetric curve with respect to the middle laying line, the only possible modifications of the form of these lines being obtainable by varying the radius of the two cranks.

A further object of this invention is to provide a modified construction eliminating the above drawback.

Generally the above described apparatus enables by simply adjusting the crank radii to obtain a laying line which is near to but not coincident with the desired one. The modified construction corrects this difference by subdividing the connecting rod laying in a plane extending through the drum axis into two sections axially displaceable relative to each other, one of said sections or connecting rod proper being articulated to its crank pin, the other section or connecting rod carrying the thread laying guide, the latter section being actuated by means of a suitable cam keyed to the crank pin and against which the latter section is biased by resilient means.

The invention further concerns a method of tracing the profile of the cam actuating the connecting rod by utilising the same machine as a machine for tracing the profile of a disc keyed to the crank pin instead of the cam, the said method consisting in tracing on the drum a line equalling the desired laying line, but axially displaced with respect of the drum and parallel with itself by an extent equalling at least the sum of the maximum lateral offset in both directions of the desired laying line with respect to the line obtainable should the thread guide be carried by the connecting rod proper, providing the latter section of the connecting rod or correcting rod with an extension carrying a tracing indicating means arranged laterally of the disc spaced in an axial direction with respect to the said rod by an extent equalling to offset of the line traced on the drum, and rotating the connecting rods and drum operatively connected thereto through small angles, the center of the thread guide being moved on each angular displacement to the offset line, a corresponding point being traced by means of the tracing indicating means on the side of the peripheral disc rim, the said points being interconnected by a continuous line and material being removed from the disc externally of the said line.



Further characteristic features of this invention will become apparent from the appended description referring to the accompanying drawings, wherein:

FIGURE 1 is a general diagrammatic view of the machine.

FIGURE 2 shows diagrammatically a mechanism for imparting to the thread guide a movement resulting from two linear straight displacements in a transverse and parallel direction, with respect to the drum axis and a longitudinal direction, respectively, perpendicular to the drum axis, effected by the combined action of two cranks acting on slotted crank plates orthogonal to each other suitably interconnected for relative displacement.

FIGURES 3 to 7 show examples of thread laying lines of the drum developed in a plane, corresponding to given movements of the thread guide, the trace of which, the drum being stationary, is indicated beside each of them (FIGURES 3*a*–7*a*).

FIGURE 8 shows a device for varying the orientation of the pressure roller fitted to the mechanism controlling the thread guide shown in FIGURE 2.

FIGURE 9 relates to a device affording the same result obtainable by the device shown in FIGURE 2, the masses performing the reciprocating motion and overall size being reduced.

FIGURES 10 and 11 are a front and a plan view, respectively, of the machine for forming from a single thread the endless annular band, equipped with the device shown in FIGURE 9;

FIGURES 12 and 13 are a front and plan view, respectively, of a device for controlling the gradual orientation of the roller pressing the thread on the drum and

FIGURE 14 shows diagrammatically the succesive positions of the pressure roller;

FIGURE 15 shows a modification of the device shown in FIGURE 9 in which one of the two cranks effecting the movement of the thread guide is replaced by a cam;

FIGURE 16 is an axial sectional view of a device for conferring a resilient pressure to the pressure roller acting on the thread as the latter is being laid on the drum.

FIGURE 17 is a plan view of FIGURE 16;

FIGURE 18 is a partial sectional view corresponding to FIGURE 16, showing the device employed for releasing the pressure roller during operations preparatory to formation of the endless annular band as well as during removal of the band;

FIGURE 19 is a part development on a plane of the drum periphery or rim, on which the desired laying line, the line more nearly close thereto obtainable by the crank mechanism shown in FIGURE 9, and the laying line offset for purposes explained hereafter are traced, respectively,

FIGURE 20 is a front view of a detail of the machine according to a modified construction partly in section on line XX—XX of FIGURE 21,

FIGURE 21 is a sectional view on line XXI—XXI of FIGURE 20,

FIGURE 22 shows diagrammatically a step of the cam tracing process.

Referring to the diagram shown in FIGURE 1, the improved machine for forming the endless annular band from a single thread comprises a drum 1 on the annular

surface of which, previously coated with an adhesive, a thread guide 2 lays an endless thread 4'. Numeral 3 denotes a device for moving the thread guide 2. The thread 4 unwinds from a spool 5, travels to an apparatus 6 lining it with a raw rubber mix, the lined thread denoted by 4' then travelling to a stretching device diagrammatically indicated by a pulley having a stationary shaft 8 and an underlying pulley with a movable shaft 9 equipped with a counterweight 7, whereupon it is fed to the thread guide 2 distributing it on the surface of the drum 1, which has been previously coated with adhesive, a pressure roller 34 pressing the thread on the drum as it is being laid.

Referring to FIGURE 2, the device shown in this figure is adapted to act on the thread guide 2 laying the coated thread 4' on the drum 1 in order to continuously move the thread guide along a closed line which is the resultant of a movement parallel with the drum axis and a movement orthogonal to the said axis.

The device comprises a rod 41 longitudinally displaceable with respect to the drum 1 in a guide 42 carried by a rod 43 perpendicular to the rod 41. The rod 43 is movable in stationary guides 44. The rod 41 ends at its end opposite to that which carries the thread guide by a cross member having a slit 45 cut therein parallel with the drum axis. The rod 43 carries at one end a cross member in which a slit 49 is cut perpendicular to the slit 45 in the rod 41. The slit 45 has a shoe 46 mounted therein, the shoe 46 being carried by a crank pin 47 rotatable about an axis 48. The slit 49 has a shoe 50 mounted therein carried by a crank pin 51 rotatable about an axis 52. The shafts extending along the axes 48, 52, respectively, are rotated, the rate of speed of the shaft 48 being twice the rate of speed of the shaft 52.

With the device of the type disclosed above the thread guides 2 may follow closed lines confining a definite surface. Examples of such closed lines are shown in FIGURES 3*a* and 7*a*, beside each of which the line along which the thread is laid on the drum is shown developed in a plane.

It will be seen that the closed lines obtained by a device of this construction are all in the form of an 8. The length of each 8-shaped figure is twice the eccentricity of the pivot 51, its width being twice the eccentricity of the pivot 47. The adjustment of the band's width is therefore obtained by varying the eccentricity of the pivot 51, the form of the various sections of the laying line on the drum, more particularly the connecting portions between the various sections on the band edges is varied by adjusting the eccentricity of the pivot 47. It will be seen that the smaller the eccentricity of the pivot 47 (FIGURES 3 and 3*a*) the larger is the radius of the connections between the sections of the laying line, while the greater the eccentricity (FIGURES 4, 4*a* and 5, 5*a*) the sharper are the connections, and still greater eccentricities result in loops. By reversing the rotation of the shaft 48 and maintaining the eccentricity of the pivot 47 similar as adopted in FIGURE 4*a*, connections result which exhibit a substantially rectilinear section (FIGURE 7).

The device shown in FIGURE 2 affords transverse rates of speeds which constantly follow those determined by the eccentrics and may therefore be varied according to fixed laws only, unless the angular rate of speed of the eccentrics on revolution is varied or the eccentrics are replaced by cams, or the rate of speed of the drum is varied during revolution thereof.

In order to operate the roller pressing the thread the device shown in FIGURE 8 may be employed, which comprises a cam 53 keyed to a pivot 51' coaxial and fixedly secured to the crank pin 51 rotating about the axis 52.

A roller 54 is pressed against a profile of the cam 53 by a bell crank lever 55, 55' capable of oscillating about the pivot 56.

The arm 55' of the bell crank lever mentioned above has anchored thereto one end of a flexible transmission cable 57, the sheath of which is denoted by 58. The other end of the cable 57 is provided with a member 62 for adjustable engagement into the slit 63 of a bell crank lever 59, 59' keyed to the pivot 31 which carries the roller 34 pressing the thread being laid, this pin 31 (which is made hollow for the thread to extend therethrough and be guided thereby) being rotatable in a suitable bush on the rod 41. The arm 59' of the bell crank lever is subjected to the action of a spring 61 tending to oscillate it and holding the cable 57 stretched at the same time causing the roller 54 to contact the cam 53.

Referring to FIGURE 9 the device diagrammatically shown in this figure is adapted to confer to the thread guide a combined motion similar to the motion transmitted by the slotted cranks 45 and 49 of the device shown in FIGURES 2 and 8, while advantageously reducing the overall size and reciprocating masses.

In this device the shafts 52 and 48 have keyed thereto crank discs 67, 68, respectively. The disc 67 is formed with a radial groove 69 which engages and holds at the desired distance from the axis of rotation the crank pin 51 articulated to the connecting rod 64. Similarly, the radial groove 70 in the crank plate 68 adjustably engages and retains the crank pin 47 articulated to the connecting rod 65. The crank disc 68 is rotated as mentioned above at an angular speed which is twice the rate of speed of the crank plate 67. The two connecting rods 64, 65 are articulated to each other at 66, the hollow pivot for the pressure roller for the thread being laid extending through the articulation pivot for the connecting rods. The axial bore in the pivot for the pressure roller has the thread extending therethrough and serves as thread guide, all as hereafter described in detail with reference to FIGURES 16, 17 and 18.

The device shown in FIGURE 2 yields a laying line made up of rectilinear sections merging into one another, while the device shown in FIGURE 9 cannot yield accurately rectilinear sections, the sections being approximately rectilinear enough for certain uses as reinforcements for tires.

Referring to FIGURES 10 and 11, the machine shown in these figures carries the mechanism operating the thread guide 2 shown in FIGURE 9, comprising two crank plates 67, 68, the latter plate rotating at twice the angular speed of the former, the plates having radial grooves therein for securing the pivot for the crank pin 51, 47 respectively.

Motion is imparted by one motor 71 which rotates through a belt 72 a shaft 73 having keyed thereto a pulley 74 over which the belt travels. The shaft 73 has keyed thereto two toothed wheels 75, 77. The toothed wheel 75 rotates, through a set of gears 76, the shaft 52 having keyed thereto the crank plate 67, and rotates, through the transmission 74' and corresponding toothed wheel pair at twice the angular speed, the shaft 48 having keyed thereto the crank plate 68.

The toothed wheel 77 rotates through a set of gears 78 a shaft 79 which rotates through a suitable bevel gearing the drum 1. By exchanging the toothed wheels in both gearings the ratio of the rotational speed of the drum 1 to the translational speed of the thread guide may be varied, thereby varying the number of windings and the angular displacement of the laying path on successive revolutions.

A variable speed transmission can be used instead of the above mentioned gearings, the transmission being interposed between the drum rotating mechanism and mechanism for translating the thread guide. The purpose may be alternatively served by a variable speed transmission determining the angular displacement of the laying path on the successive revolution of the drum, while the interchangeable toothed wheel gearing may be employed for determining the pitch of zig-zag laying of the thread only.

The machine may be provided with an automatic stop device known per se which is released as a predetermined number of windings has been laid.

FIGURES 12 and 13 show the device for gradually varying orientation of the pressure roller 34 fitted to the device shown in the preceding figures, more particularly to the crank plate 67. The device comprises a cam 53' keyed to a pivot 51' on the axial extension of the crank pin 51. The profile of the cam 53' has a roller 54' rolling thereon, the roller 54' being carried by a bell crank lever 55, 55' capable of oscillating about a pivot. The arm 55' of the bell crank lever is formed with a longitudinal slit 81 adjustably engaging in a radial direction the pivot 80 of the connecting rod 82 articulated at its other end to the end of the lever 83 keyed to the pivot carrying the pressure roller 34. Rotation of the crank plate 67 therefore orientates the roller 34 as desired by means of the cam 53'.

The successive positions of the rollers 34 are shown in FIGURE 14.

Referring to FIGURE 15, in the device shown therein, the crank plate 67 actuating the connecting rod 64 is maintained, the other crank plate 68 being replaced on the shaft 48 by a cam 92 with the profile of which the roller 91 is caused to contact, the roller 91 being carried by a strap 90 mounted on the end of the rod 65' connected at its other end at 66 with the connecting rod 64 at the pivot of the pressure roller. The strap 90 is articulated at 93 to a lever 94 articulated in turn at 95 to a fixed point. In the example shown the cam 92 comprises two symmetrical parts, so that the number of revolutions of the shaft 48 equals the number of revolutions of the shaft 52 carrying the plate 67.

Referring to FIGURES 16, 17 and 18 which show the pressure roller 34 pressing the thread being laid on the drum 1, the numeral 96 denotes a coiled spring, conferring the necessary resilient pressure to the roller 34 and mounted for this purpose in an annular chamber longitudinally formed between the pivot 31 and pivot 66 articulating the levers 64 and 65 to each other, the said levers controlling movement of the thread guide 2 formed by the axial bore in the pivot 31. The forked end 33 of the pivot 31 supports the shaft 34' on which the pressure roller 34 rotates.

In order to release the pressure roller 34 and lift it from the surface of the drum 1 any time this is required, a handle-shaped disc 97 is provided, having holes 98 bored therethrough and securedly fixed to the end of the hollow pivot 31. The ends of the pivot 66 articulating together the levers 64 and 65 have secured thereto two rods 99, the position of which is such as to engage with holes 98 when the latter are caused to coincide with the said rods. The engagement position shown in FIGURE 16 holds the roller 34 in the operative position. In order to release it from this position and set free the surface of the drum 1, the disc 97 is lifted and carries along the pivot 31 to which is securely fixed, hence the pressure roller 34. In order to maintain the pressure roller in the lifted position, it will be sufficient to slightly angularly displace the disc 97 to move the rods 99 out of the alignment holes 98, such as to the position indicated by 99' in FIGURE 20.

The spring 96 holds the disc 97 pressed against the heads of the rods 99, so that the pressure roller 34 remains in its lifted inoperative position until the disc 97 is imparted an equal contrary angular movement bringing the rods 99 into register with the holes 98.

The previously described embodiments permit of laying the thread on the drum rim along a wide variety of laying lines but do not afford particularly desirable laying lines. According to a further aspect of this invention shown with reference to FIGURES 19 to 21 the thread can be laid on the drum along any desired laying line.

In FIGURE 19, 1 denotes the drum surface on which a broken line B shows the desired thread laying line, and a full line A shows the laying line which could be obtained by the machine according to the above described construction. The modification improves the abovementioned construction to permit of laying the thread along the line B.



To this end the connecting rod 64 lying in the plane extending through the drum axis is subdivided into two tubular portions telescopically sliding within each other, the former portion 101, acting as a connecting rod proper and being articulated to the crank pin 51 through a sleeve 102, the latter portion or connecting rod denoted by 64 carrying the thread guide 2 for laying the thread. The displacement of the connecting rod with respect to the connecting rod proper is obtained by means of a cam 103 keyed to the crank pin 51. The connecting rod has secured thereto a support 104 for a roller 106 rotatable on a pivot 105 and rolling in contact with a cam 103. The connecting rod is biased towards the cam 103, so that the roller 106 rolls in contact therewith, by a helical spring 107 acting at one end against the flange 108 provided within the connecting rod and bearing at its other end on a flanged sleeve 109 screwed on a rod 110, the latter being secured in turn to a cylindrical extension 111 on the sleeve 102, the connecting rod proper being fitted on said extension.

The crank pin 51, mounted in the same manner as in the previously described construction for radial displacement within a slit or groove in the crankplate 67 has keyed thereto a cam 53' controlling through a bell crank arm and a rod (not shown on the drawing for the sake of clearness, but arranged as shown in FIGURES 12 and 14), orientation of the roller adapted to press the thread against the drum as it is being laid.

It will be obvious that through a suitable construction of the cam 103, any predetermined laying line for the thread on the rotary drum can be obtained. For instance, the construction shown on the drawing affords a laying line as shown at B in FIGURE 19, by previously arranging the crank pins in a suitable position for tracing the line A closely approaching the desired line B.

The invention further concerns a method of tracing the profile of the cam 103 actuating the connecting rod 64 by utilizing the same machine as a device for tracing the profile on a disc keyed to the crank pin instead of the cam.

As shown in FIGURE 22, in order to carry out this method a disc 103' is keyed to the crank pin 51, the disc 103' exceeding or equalling in radius the maximum radius of the cam 103. The support 104 for the roller 106 is fixed to a support 112 carrying a nut 113 into which a screw 114 having a milled head is screwed.

The screw 114 abuts an abutment 115 welded to the arm 116 supporting the pivot 117 to which the crank arm is pivoted, this bell crank arm controlling orientation of the roller pressing the thread against the drum. It will be seen that, by rotating the screw 114 the rod 64 is axially displaced, thereby removing the roller 106 from the periphery of the disc 103'. An extension 118 is welded to the support 104, the said extension being arranged laterally of the disc and provided with a hole 119 for the purposes to be described hereafter.

The process for tracing the cam 103 is as follows: A line C is drawn on the drum 1 (FIGURE 19), said line being made up, for instance, of the desired laying line B axially displaced with respect to the drum and parallel with itself by an extent *c* equalling at least the sum of the maximum lateral offsets in both direction *a b*, (equalling each other in the example shown on the drawings) of the desired laying line B with respect to the line A obtainable where the connecting rod would be directly pivoted to the crank pin; the spacing of the axis of the hole 119 and periphery of the roller 106 is selected to equal the above defined length *c*. The screw 114 having a milled head is subsequently acted upon to move the centre of the thread guide to any point on the curve C and a point is drawn by means of a tracing pin, fitted through the hole 119, on the front face of the disc 103'; the driving shaft of the machine is then sequentially rotated through small angles, further points being drawn still in the manner

described above on the face of the disc **103'**; it will be obvious that upon removing material **103a** from the disc externally of the line C' the cam **103** is accurately obtained.

The cam tracing method is very quick and simple. Of course, every desired laying line requires a special cam. The cams can be each stored with a pair of tools adapted to accurately define the eccentricity of both cranks in order to obtain a determined laying line.

It will be understood that, the principle of the invention being left unaltered embodiments of the method and constructional details of the machine can be widely varied from the non limiting example described and illustrated without departing from the scope of this invention.

What I claim is:

1. A method of forming annular bands from at least one endless thread on a collapsible drum, said annular bands being suitable for reinforcement of tire casings for motor vehicle wheels, comprising the steps of providing a drum, coating the periphery of said drum with an adhesive, rotating the drum, stretching the thread and laying it on the rotating drum while the thread, immediately before its contact with the drum periphery, is subjected to a first reciprocation between the sides of said drum and is simultaneously subjected to a second reciprocation in a direction perpendicular to the direction of said first reciprocation, the direction of said second reciprocation and the rate of both reciprocations being so selected that said thread follows, immediately before its contact with the drum periphery, a closed path substantially of figure 8-shape lying in a plane parallel with the drum axis.

2. A method as claimed in claim 1, wherein the movement of the thread along said path is such that the displacement of the thread near the drum sides takes place in the same direction as the movement of the drum periphery.

3. A method as claimed in claim 1, wherein the rate of feed of the thread is varied upon laying the latter on the drum periphery.

4. A method as claimed in claim 1, wherein, during the laying of the thread on the drum periphery, the speed of rotation of the drum is varied.

5. A method as claimed in claim 1, wherein at least two threads are simultaneously laid on the drum periphery along lines parallel with each other.

6. A method as claimed in claim 1, wherein at least two threads are simultaneously laid on the drum periphery along lines independent of each other.

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